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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/734,226	12/15/2003	Kye Nam Lee	40296-0054	8682
26633	7590	12/07/2005	EXAMINER	
HELLER EHRMAN WHITE & MCAULIFFE LLP 1717 RHODE ISLAND AVE, NW WASHINGTON, DC 20036-3001			CHEN, ERIC BRICE	
			ART UNIT	PAPER NUMBER
			1765	
DATE MAILED: 12/07/2005				

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/734,226

Applicant(s)

LEE ET AL.

Examiner

Eric B. Chen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 24 October 2005.  
 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.  
 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1 and 2 is/are pending in the application.  
 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.  
 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.  
 6) ☒ Claim(s) 1 and 2 is/are rejected.  
 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.  
 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.  
 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
 a) ☒ All b) ☐ Some \* c) ☐ None of:  
 1. ☒ Certified copies of the priority documents have been received.  
 2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)  
 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)  
 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
 Paper No(s)/Mail Date \_\_\_\_\_.  
 4) ☐ Interview Summary (PTO-413)  
 Paper No(s)/Mail Date. \_\_\_\_\_.  
 5) ☐ Notice of Informal Patent Application (PTO-152)  
 6) ☐ Other: \_\_\_\_\_.

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ying (U.S. Patent No. 6,759,263), in view of Abraham et al. (U.S. Patent No. 6,452,764), in further view of Wolf, *Silicon Processing for the VLSI Era*, Vol. 4, Lattice Press (2002) ("Wolf IV"), in further view of Wolf et al., *Silicon Processing for the VLSI Era*, Vol. 1, Lattice Press (1986) ("Wolf I").

4. As to claim 1, Ying discloses a method for manufacturing MTJ cell of magnetic random access memory (MRAM) (column 1, lines 8-12) comprising: forming a stacked

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structure (202) (column 3, lines 12-13; Figure 2A) of a pinned magnetic layer (210) (column 3, lines 25-26; column 12, lines 18-21), an alumina layer (208) (column 3, lines 21-23) and a free magnetic layer (206) (column 3, lines 14-15); forming a hard mask layer (218/230) (column 3, line 52-54) on the stacked structure (column 3, lines 47-50; Figure 2B); patterning the hard mask (218/230) layer via a photoetching process (column 4, lines 9-18) using a MTJ cell mask to form a hard mask layer pattern exposing a portion of the free magnetic layer (Figure 2F); and oxidizing the exposed portion of the free magnetic layer (column 5, lines 10-20); and patterning a MTJ cell by etching the stacked structure (column 7, lines 23-30).

5. Ying does not expressly disclose subjecting the exposed portion of the free magnetic layer to a halo ion implant process. Abraham teaches a method for manufacturing MTJ cell of magnetic random access memory (MRAM) (column 10, lines 1-7; Figure 13A), including oxygen ion implantation of the structure (column 10, lines 7-10) to increase the insulative characteristics on the sides of the tunneling region (column 10, lines 22-24) and reduce undesirable effects, such as the non-ideal behavior in the magnetization reversal process (column 3, lines 24-27, lines 42-47). Wolf IV teaches a method of halo implantation for a self-aligned MOS structures, in which the implant step is performed at a high angle relative to the substrate to implant ions at a precise depth and lateral distance from the gate (pages 7-8). For self-aligned MOS structures, the metal gate inherently functions as a mask and is thus analogous to Ying's hard mask (218/230). See Streetman, *Solid State Electronic Devices*, Prentice Hall (1990), page 323. Thus, a halo implant permits the implantation of ions laterally

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from the edge of the hard mask. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to subject the exposed portion of the free magnetic layer to a halo ion implant process. One who is skilled in the art would be motivated to reduce undesirable effects in MRAM devices by increasing the insulative characteristics on the sides of the tunneling region.

Furthermore, one who is skilled in the art would be motivated to ion implant laterally under the edge of the hard mask in a precise manner when increasing the insulative characteristics on the sides of the tunneling region.

6. Abraham does not expressly disclose that the ion implant process converts the state of the exposed portion into an amorphous state and that the exposed portion of the free magnetic layer is in the amorphous state. However, Wolf I teaches that ion implantation can cause crystal defects or amorphous layers in crystalline targets and that the damage can be removed by thermal processing (page 283). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to convert the state of the exposed portion into an amorphous state and that the exposed portion of the free magnetic layer is in the amorphous state, because Wolf I teaches that ion implantation results in the formation of an amorphous region.

### ***Claim Rejections - 35 USC § 103***

7. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ying, in view of Abraham, in further view of Wolf I, in further view of Wolf IV, in further view of Hook et al. (U.S. Patent No. 6,083,794).

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8. As to claim 2, Ying does not expressly disclose that the halo ion implant process is performed in a manner that a tilt angle ranges from 0 to 90 degrees and an ion is implanted from four directions. However, Hook teaches that to achieve symmetry during ion implantation, angled ion implantation is applied in four rotations (column 1, lines 21-29; column 2, lines 1-2). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to performed the halo ion implant process in a manner that a tilt angle ranges from 0 to 90 degrees and an ion is implanted from four directions. One who is skilled in the art would be motivated to achieve a symmetrical ion implantation profile.

### ***Response to Arguments***

9. Applicants' arguments, (Applicants' Remarks, pages 3-4), filed Oct. 24, 2005, with respect to the rejection of claims 1 and 2 under 35 U.S.C. 103(a) have been fully considered and are persuasive. Applicants have pointed out that the previously cited Ying, Abraham and Wolf IV references do not disclose the newly amended claim limitation of "to convert the state of the exposed portion into an amorphous state" (page 3). Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Wolf I.

### ***Conclusion***

10. Applicants' amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

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§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric B. Chen whose telephone number is (571) 272-2947. The examiner can normally be reached on Monday through Friday, 8AM to 4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

EBC  
Nov. 28, 2005

MICHAEL G. NORTON  
SUPERVISORY PATENT EXAMINER

*Handwritten signature*